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Saraswat et al.

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(54) **DATA EXCHANGE TECHNOLOGY**

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(73) Assignee: **Accenture Global Services Limited**, Dublin (IE)

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(22) Filed: **Aug. 30, 2012**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
H04L 12/24 (2006.01)
H04L 29/06 (2006.01)
H04L 29/08 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 41/02*** (2013.01); ***H04L 63/08*** (2013.01); *H04L 63/0435* (2013.01); *H04L 41/5064* (2013.01); *H04L 67/10* (2013.01)

(58) **Field of Classification Search**
CPC H04L 63/08; H04L 41/02; H04L 67/10; H04L 41/5064; H04L 63/0435
USPC 726/4, 6, 9, 12; 713/1.167, 168, 169; 709/238, 223, 224, 248, 203, 208
See application file for complete search history.

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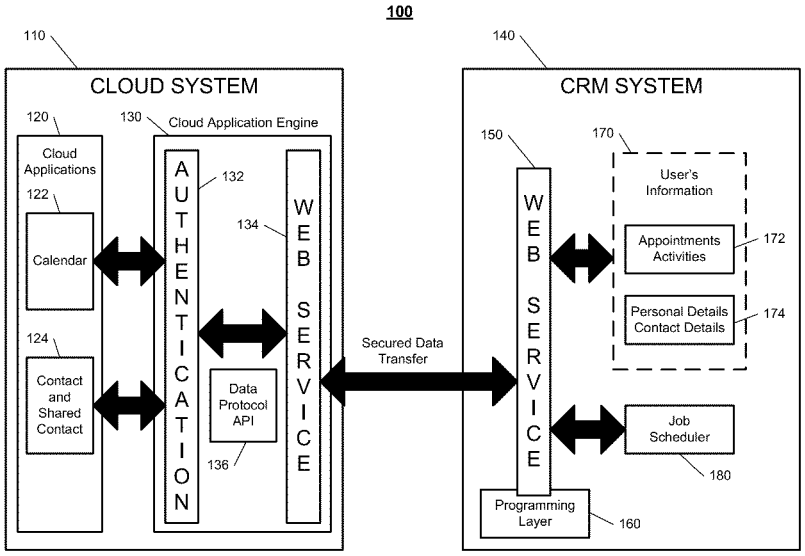
(57) **ABSTRACT**

A data exchange adaptor that synchronizes data between an enterprise system operated by a company and a cloud-based system operated by a third party other than the company. The data exchange adaptor enables exchange of data between the enterprise system and the cloud-based system and controls storage and retrieval of data at the enterprise system and the cloud-based system. The data exchange adaptor also performs transport level security for communications that exchange data between the enterprise system and the cloud-based system and access level security for data stored to the enterprise system and the cloud-based system. The data exchange adaptor further schedules synchronization of data between the enterprise system and the cloud-based system and allows the enterprise system to retain control over the synchronization of data between the enterprise system and the cloud-based system.

19 Claims, 20 Drawing Sheets



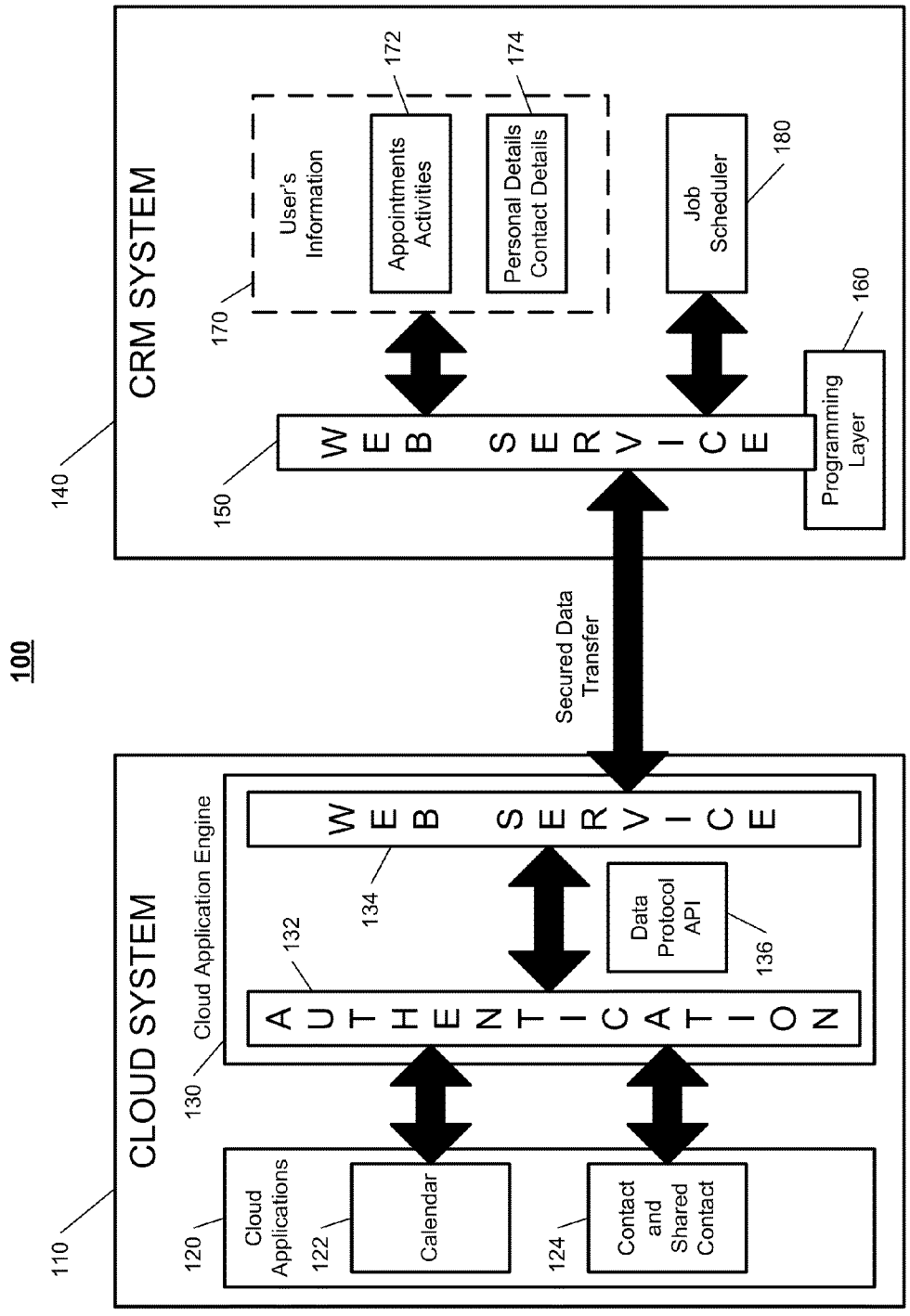

100
CRM SYSTEM
140
User's Information
170
Appointments Activities
172
Personal Details Contact Details
174
Job Scheduler
180
Programming Layer
160
WEB SERVICE
150
Secured Data Transfer
CLOUD SYSTEM
110
Cloud Application Engine
130
WEB SERVICE
134
AUTHENTICATION
132
Data Protocol API
136
Cloud Applications
120
Calendar
122
Contact and Shared Contact
124

FIG. 1

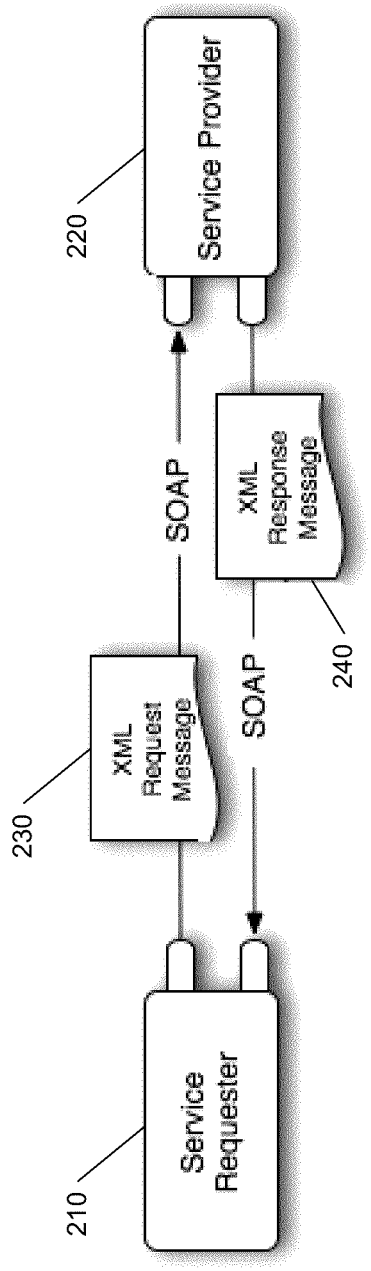

Service Provider
220
SOAP
XML Response Message
240
XML Request Message
230
SOAP
Service Requester
210

FIG. 2

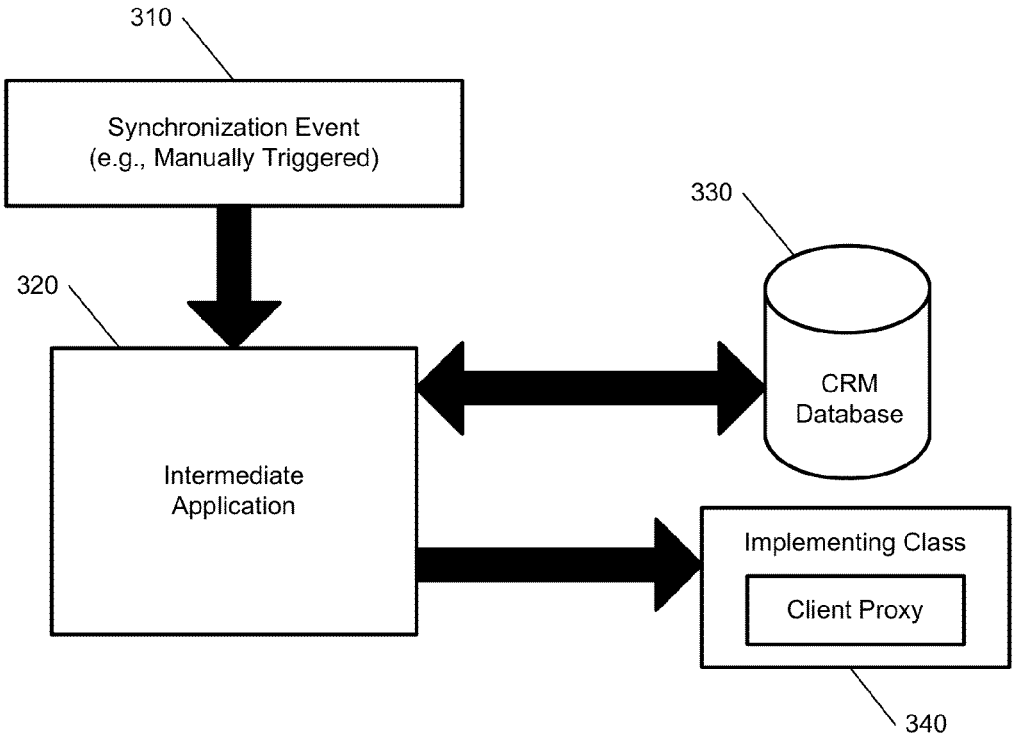

310
Synchronization Event
(e.g., Manually Triggered)
330
320
CRM
Database
Intermediate
Application
Implementing Class
Client Proxy
340

FIG. 3

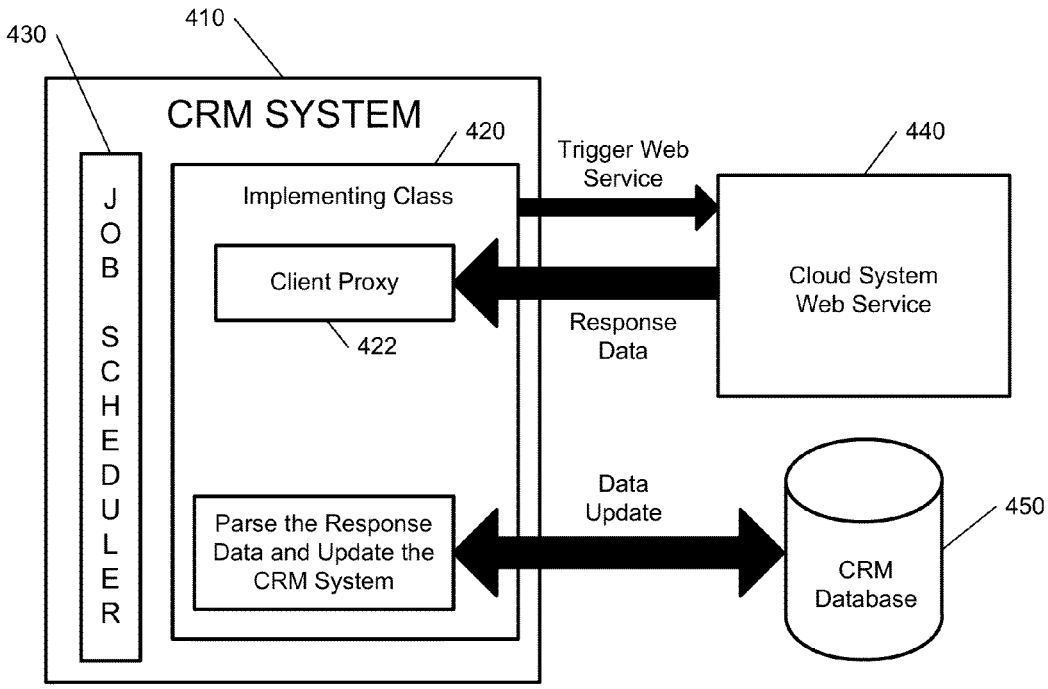

430
410
CRM SYSTEM
420
JOB SCHEDULER
Implementing Class
Client Proxy
422
Parse the Response Data and Update the CRM System
Trigger Web Service
Response Data
440
Cloud System Web Service
Data Update
450
CRM Database

FIG. 4

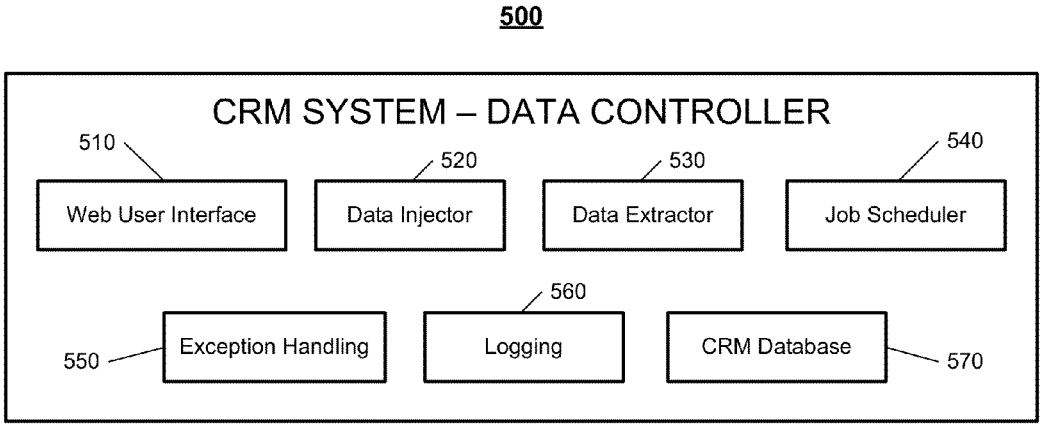

500
CRM SYSTEM – DATA CONTROLLER
510
Web User Interface
520
Data Injector
530
Data Extractor
540
Job Scheduler
560
550
Exception Handling
Logging
CRM Database
570

FIG. 5

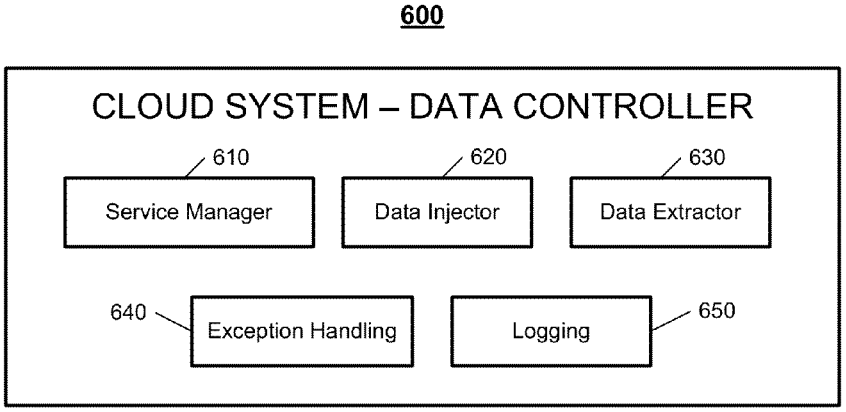

600
CLOUD SYSTEM – DATA CONTROLLER
610
Service Manager
620
Data Injector
630
Data Extractor
640
Exception Handling
Logging
650

FIG. 6

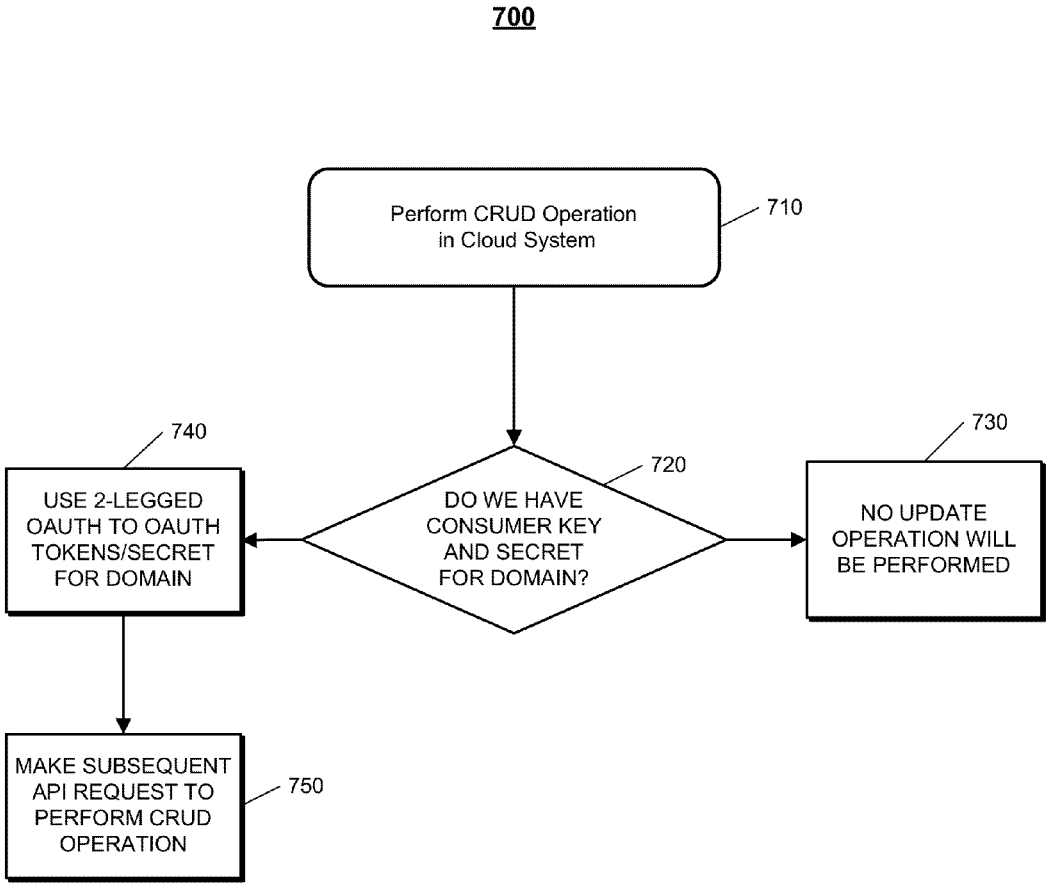

700
Perform CRUD Operation in Cloud System
710
DO WE HAVE CONSUMER KEY AND SECRET FOR DOMAIN?
720
USE 2-LEGGED OAUTH TO OAUTH TOKENS/SECRET FOR DOMAIN
740
NO UPDATE OPERATION WILL BE PERFORMED
730
MAKE SUBSEQUENT API REQUEST TO PERFORM CRUD OPERATION
750

FIG. 7

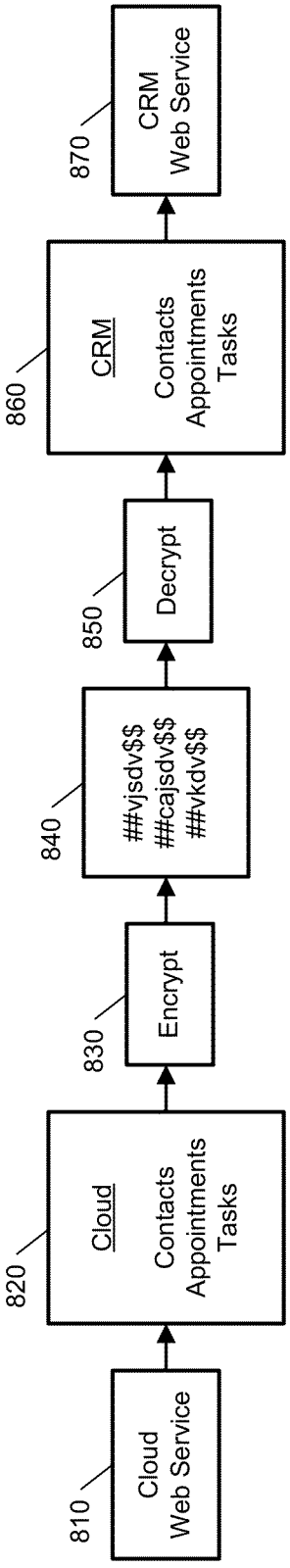

810
Cloud
Web Service
820
Cloud
Contacts
Appointments
Tasks
830
Encrypt
840
##vjsdv$$
##cajsdv$$
##vkdv$$
850
Decrypt
860
CRM
Contacts
Appointments
Tasks
870
CRM
Web Service

FIG. 8

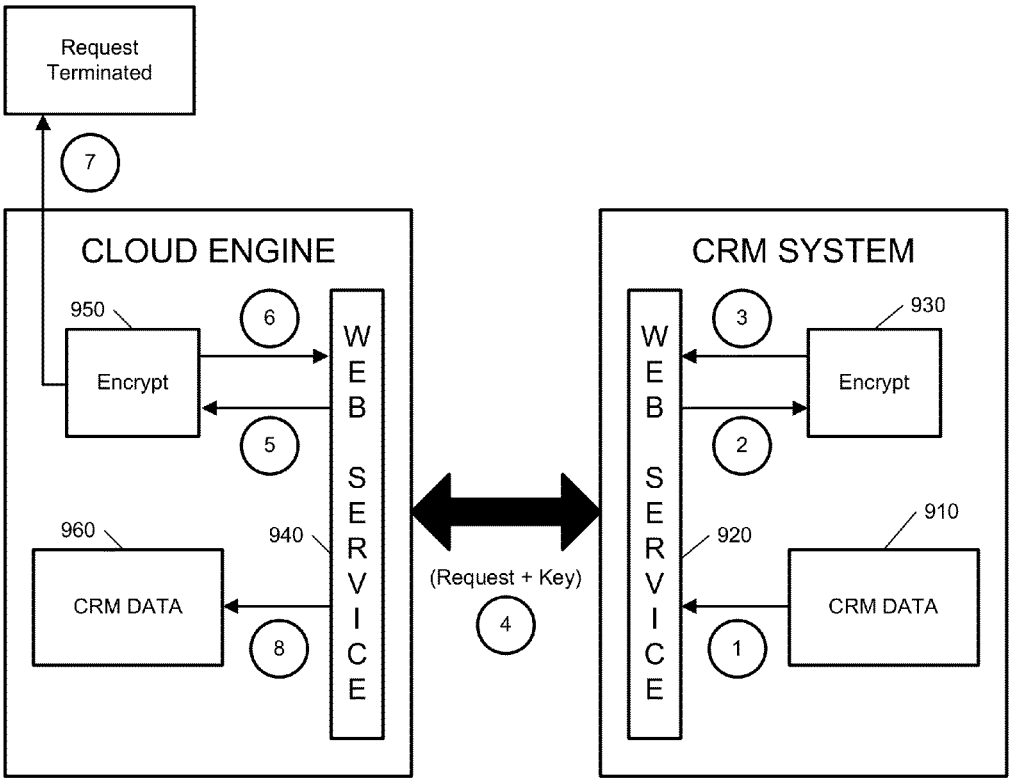

Request Terminated
7
CLOUD ENGINE
950
Encrypt
6
5
960
CRM DATA
940
8
WEB SERVICE
(Request + Key)
4
CRM SYSTEM
WEB SERVICE
3
2
930
Encrypt
920
1
910
CRM DATA

FIG. 9

1000

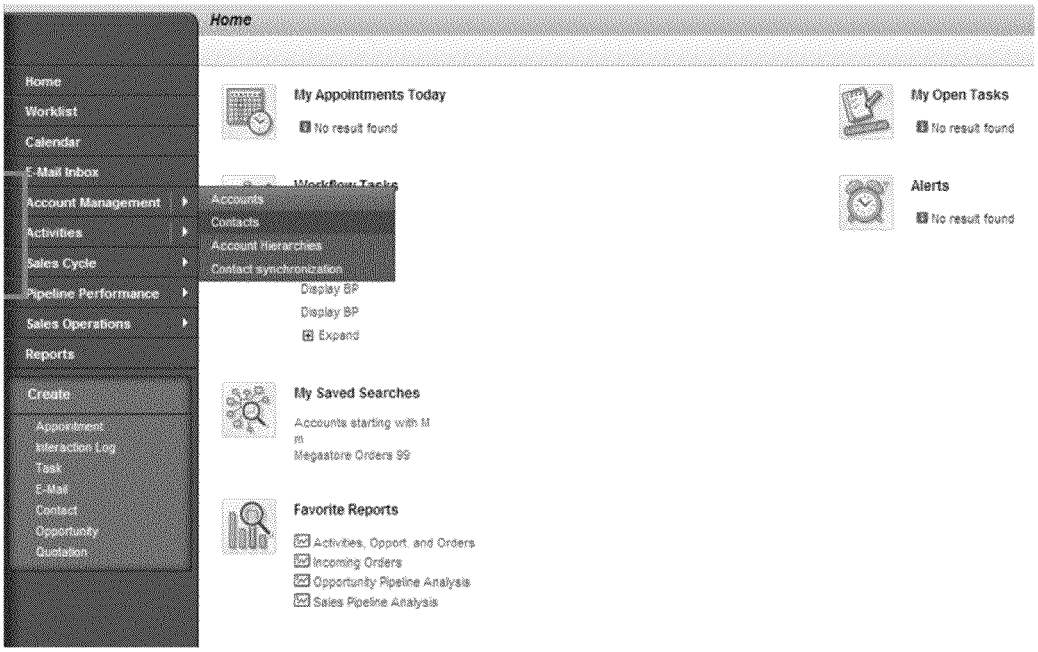

Home
Home
Worklist
Calendar
E-Mail Inbox
Account Management
Activities
Sales Cycle
Pipeline Performance
Sales Operations
Reports
Create
Appointment
Interaction Log
Task
E-Mail
Contact
Opportunity
Quotation
Accounts
Contacts
Account Hierarchies
Contact synchronization
My Appointments Today
No result found
My Open Tasks
No result found
Alerts
No result found
Display BP
Display BP
Expand
My Saved Searches
Accounts starting with M
m
Megastore Orders 99
Favorite Reports
Activities, Opport. and Orders
Incoming Orders
Opportunity Pipeline Analysis
Sales Pipeline Analysis

FIG. 10

1100

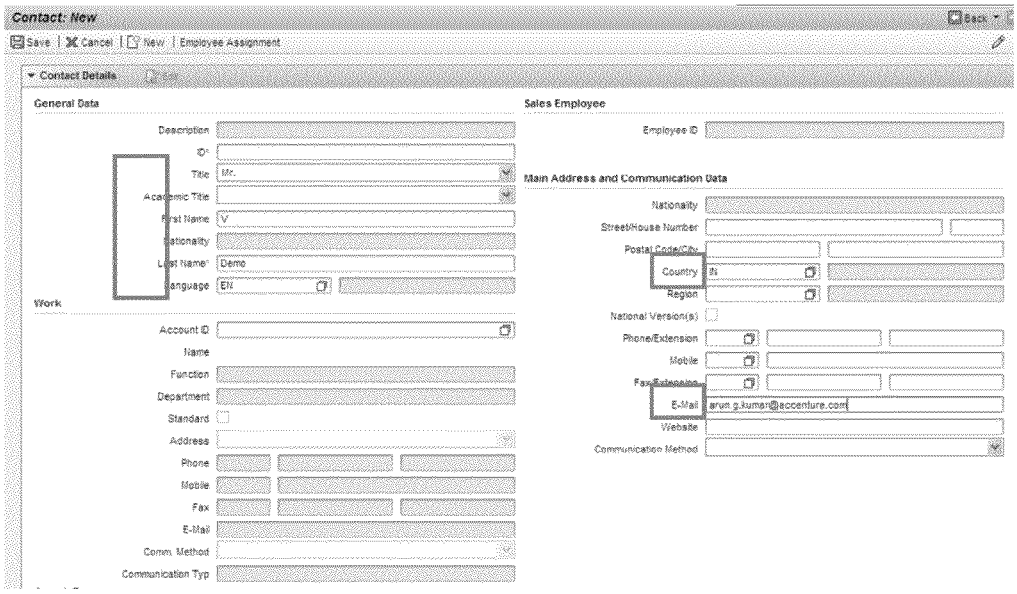

Contact: New
Back
Save
Cancel
New
Employee Assignment
Contact Details
Edit
General Data
Description
ID*
Title
Mr.
Academic Title
First Name
V
Nationality
Last Name
Demo
Language
EN
Work
Account ID
Name
Function
Department
Standard
Address
Phone
Mobile
Fax
E-Mail
Comm. Method
Communication Typ
Sales Employee
Employee ID
Main Address and Communication Data
Nationality
Street/House Number
Postal Code/City
Country
IN
Region
National Version(s)
Phone/Extension
Mobile
Fax/Extension
E-Mail
arun.g.kumar@accenture.com
Website
Communication Method

FIG. 11

1200

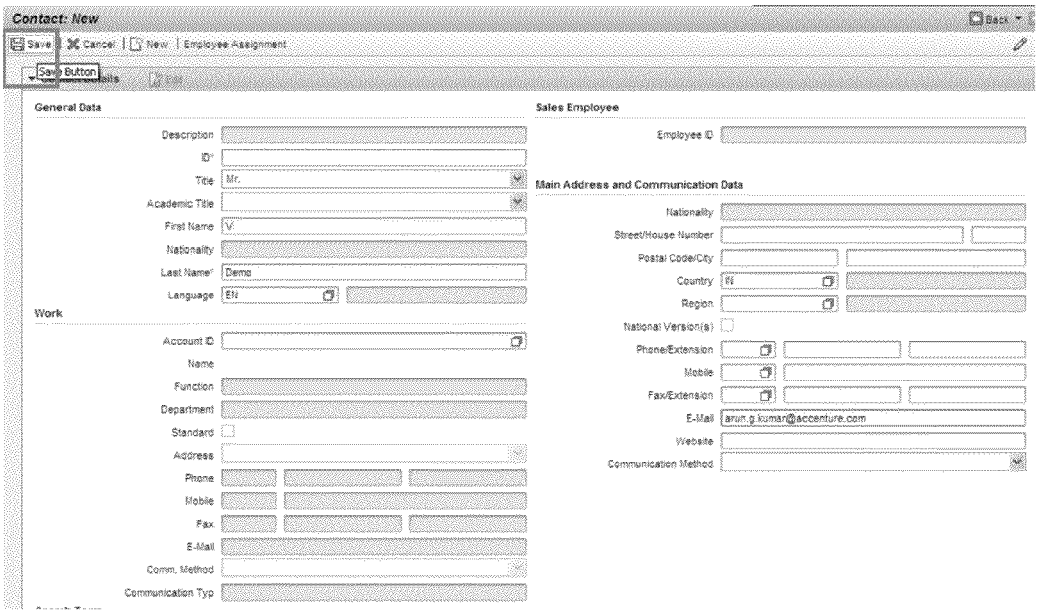

Contact: New
Back
Save
Cancel
New
Employee Assignment
Save Button
General Data
Description
ID*
Title
Mr.
Academic Title
First Name
V
Nationality
Last Name*
Demo
Language
EN
Work
Account ID
Name
Function
Department
Standard
Address
Phone
Mobile
Fax
E-Mail
Comm. Method
Communication Typ
Sales Employee
Employee ID
Main Address and Communication Data
Nationality
Street/House Number
Postal Code/City
Country
IN
Region
National Version(s)
Phone/Extension
Mobile
Fax/Extension
E-Mail
arun.g.kumar@accenture.com
Website
Communication Method

FIG. 12

1300

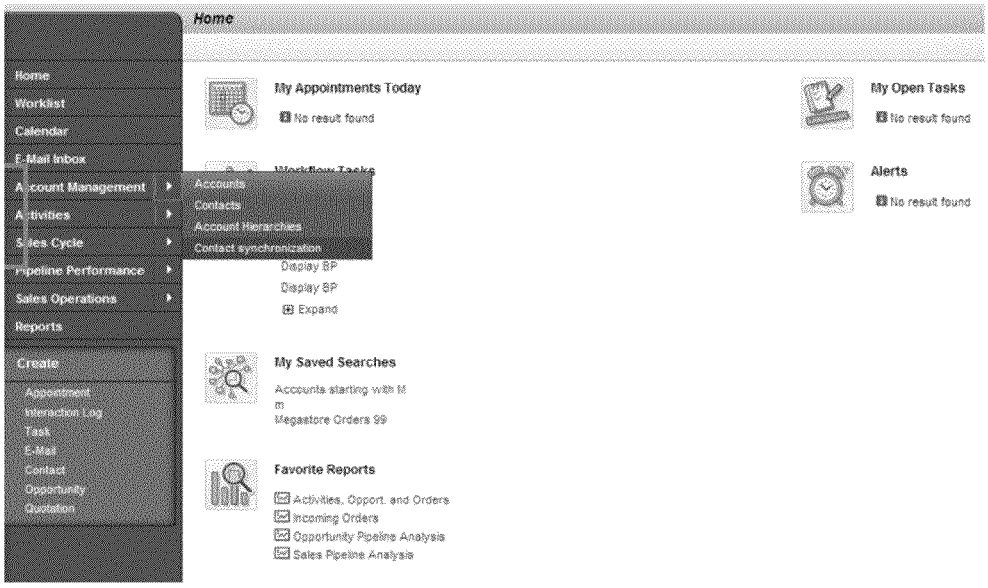

Home
Home
Worklist
Calendar
E-Mail Inbox
Account Management
Activities
Sales Cycle
Pipeline Performance
Sales Operations
Reports
Create
Appointment
Interaction Log
Task
E-Mail
Contact
Opportunity
Quotation
Accounts
Contacts
Account Hierarchies
Contact synchronization
My Appointments Today
No result found
My Open Tasks
No result found
Alerts
No result found
Display BP
Display BP
Expand
My Saved Searches
Accounts starting with M
m
Megastore Orders 99
Favorite Reports
Activities, Opport. and Orders
Incoming Orders
Opportunity Pipeline Analysis
Sales Pipeline Analysis

FIG. 13

1400

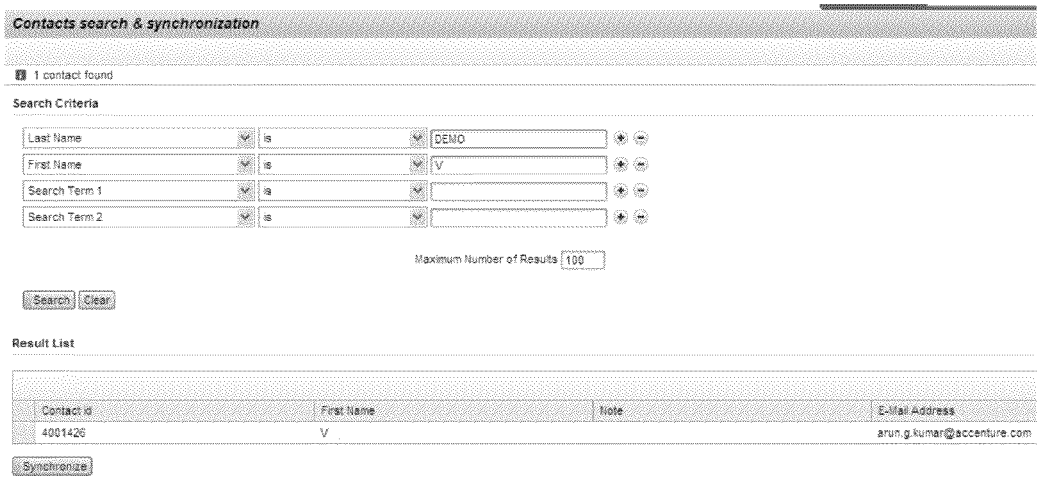

Contacts search & synchronization
1 contact found
Search Criteria
Last Name
is
DEMO
First Name
is
V
Search Term 1
is
Search Term 2
is
Maximum Number of Results
100
Search
Clear
Result List
Contact id
First Name
Note
E-Mail Address
4001426
V
arun.g.kumar@accenture.com
Synchronize

FIG. 14

1500

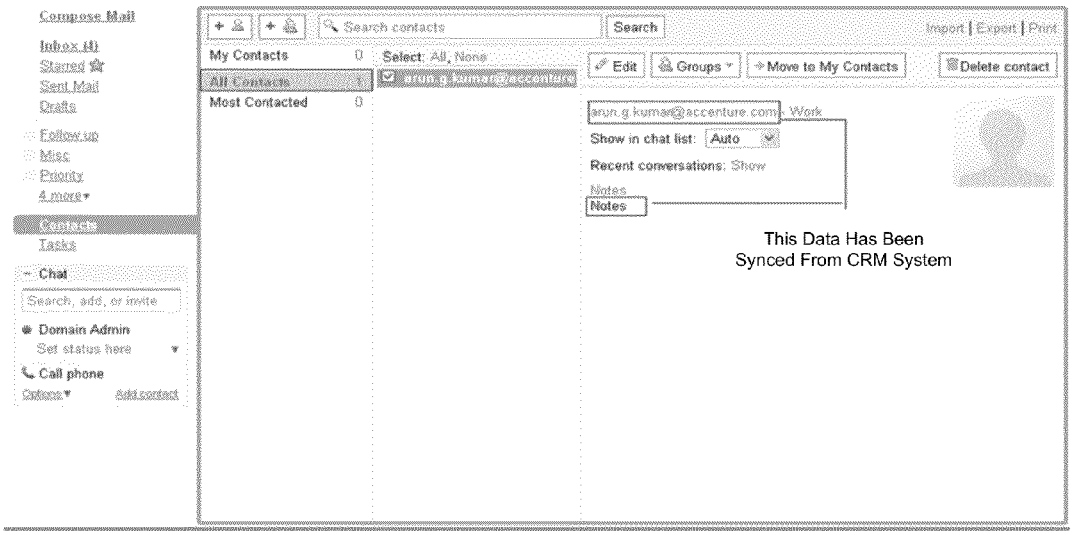

Compose Mail
Inbox (1)
Starred
Sent Mail
Drafts
Follow up
Misc
Priority
4 more
Contacts
Tasks
Chat
Search, add, or invite
Domain Admin
Set status here
Call phone
Options
Add contact
Search contacts
Search
Import | Export | Print
My Contacts 0
All Contacts
Most Contacted 0
Select: All, None
Edit
Groups
Move to My Contacts
Delete contact
arun.g.kumar@accenture.com Work
Show in chat list: Auto
Recent conversations: Show
Notes
Notes
This Data Has Been
Synced From CRM System

FIG. 15

1600

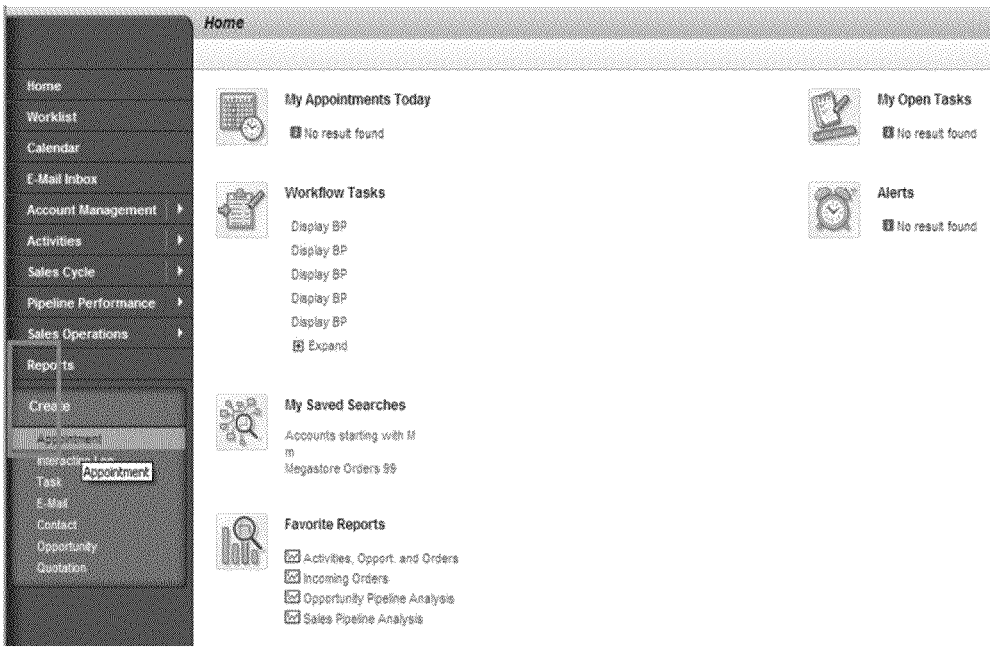

Home
Home
Worklist
Calendar
E-Mail Inbox
Account Management
Activities
Sales Cycle
Pipeline Performance
Sales Operations
Reports
Create
Appointment
Task
E-Mail
Contact
Opportunity
Quotation
Appointment
My Appointments Today
No result found
My Open Tasks
No result found
Workflow Tasks
Display BP
Display BP
Display BP
Display BP
Display BP
Expand
Alerts
No result found
My Saved Searches
Accounts starting with M
m
Megastore Orders 99
Favorite Reports
Activities, Opport. and Orders
Incoming Orders
Opportunity Pipeline Analysis
Sales Pipeline Analysis

FIG. 16

1700

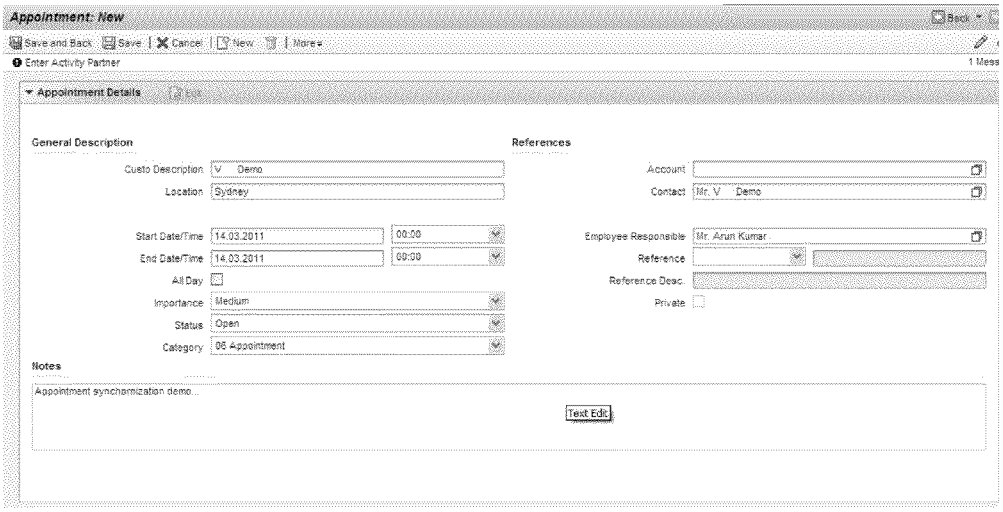

Appointment: New
Back
Save and Back
Save
Cancel
New
More
Enter Activity Partner
1 Mess
Appointment Details
Edit
General Description
References
Custo Description
V Demo
Location
Sydney
Account
Contact
Mr. V Demo
Start Date/Time
14.03.2011
00:00
End Date/Time
14.03.2011
00:00
All Day
Importance
Medium
Status
Open
Category
06 Appointment
Employee Responsible
Mr. Arun Kumar
Reference
Reference Desc.
Private
Notes
Appointment synchronization demo...
Text Edit

FIG. 17

1800

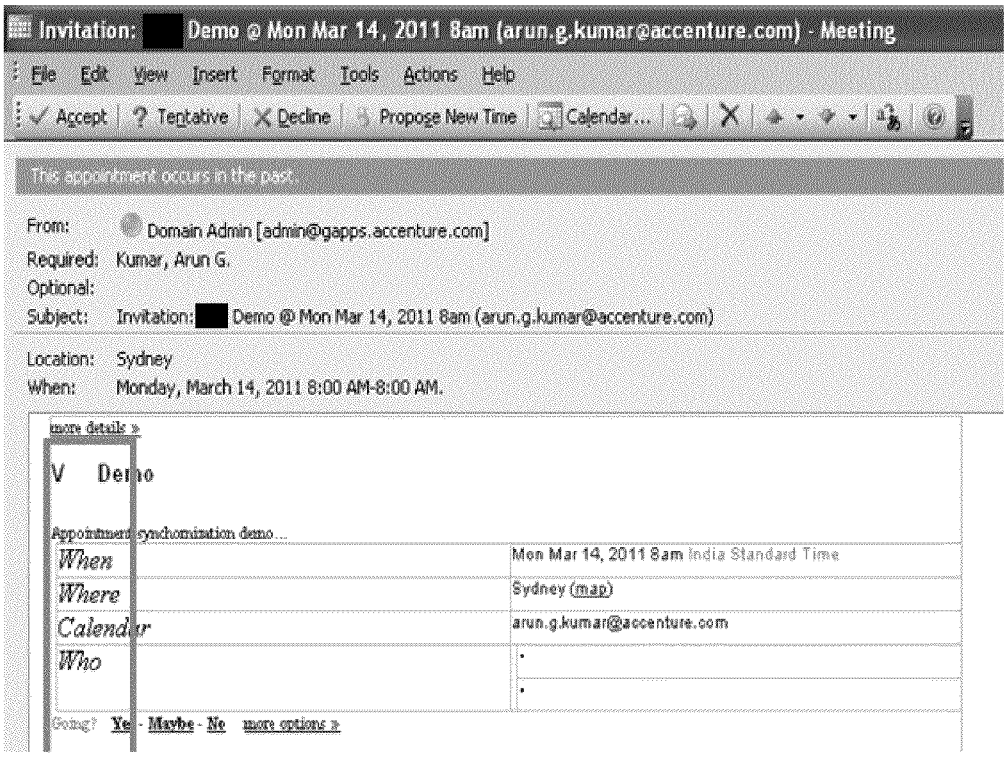

Invitation: [redacted] Demo @ Mon Mar 14, 2011 8am (arun.g.kumar@accenture.com) - Meeting
File Edit View Insert Format Tools Actions Help
Accept Tentative Decline Propose New Time Calendar...
This appointment occurs in the past.
From: Domain Admin [admin@gapps.accenture.com]
Required: Kumar, Arun G.
Optional:
Subject: Invitation: [redacted] Demo @ Mon Mar 14, 2011 8am (arun.g.kumar@accenture.com)
Location: Sydney
When: Monday, March 14, 2011 8:00 AM-8:00 AM.
more details »
V Demo
Appointment synchronization demo ...
When
Mon Mar 14, 2011 8am India Standard Time
Where
Sydney (map)
Calendar
arun.g.kumar@accenture.com
Who
Going? Yes - Maybe - No more options »

FIG. 18

1900

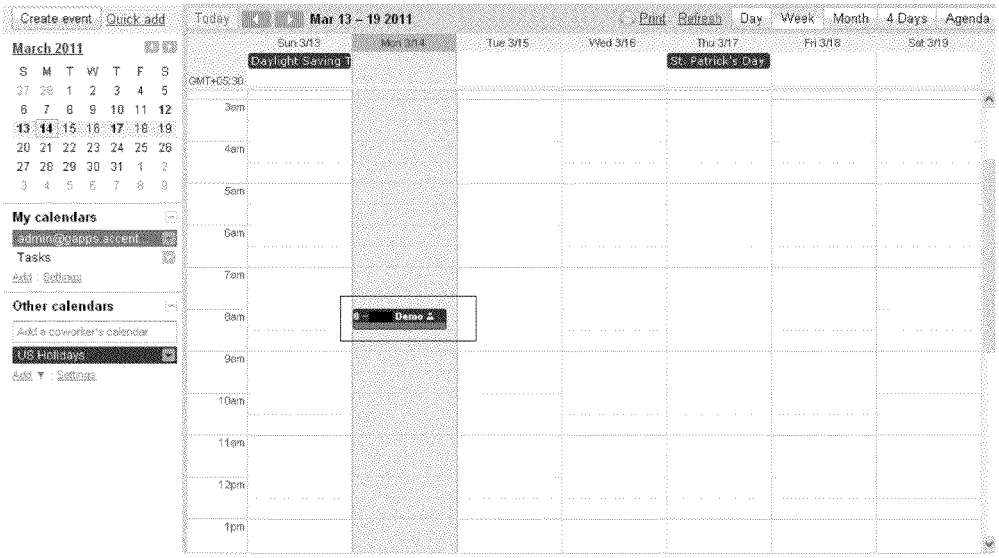

Create event
Quick add
Today
Mar 13 – 19 2011
Print
Refresh
Day
Week
Month
4 Days
Agenda
March 2011
S M T W T F S
My calendars
admin@gapps.accent
Tasks
Add | Settings
Other calendars
Add a coworker's calendar
US Holidays
Add | Settings
Sun 3/13
Mon 3/14
Tue 3/15
Wed 3/16
Thu 3/17
Fri 3/18
Sat 3/19
Daylight Saving
St. Patrick's Day
GMT+05:30
3am
4am
5am
6am
7am
8am
9am
10am
11am
12pm
1pm
Demo 2

FIG. 19

2000

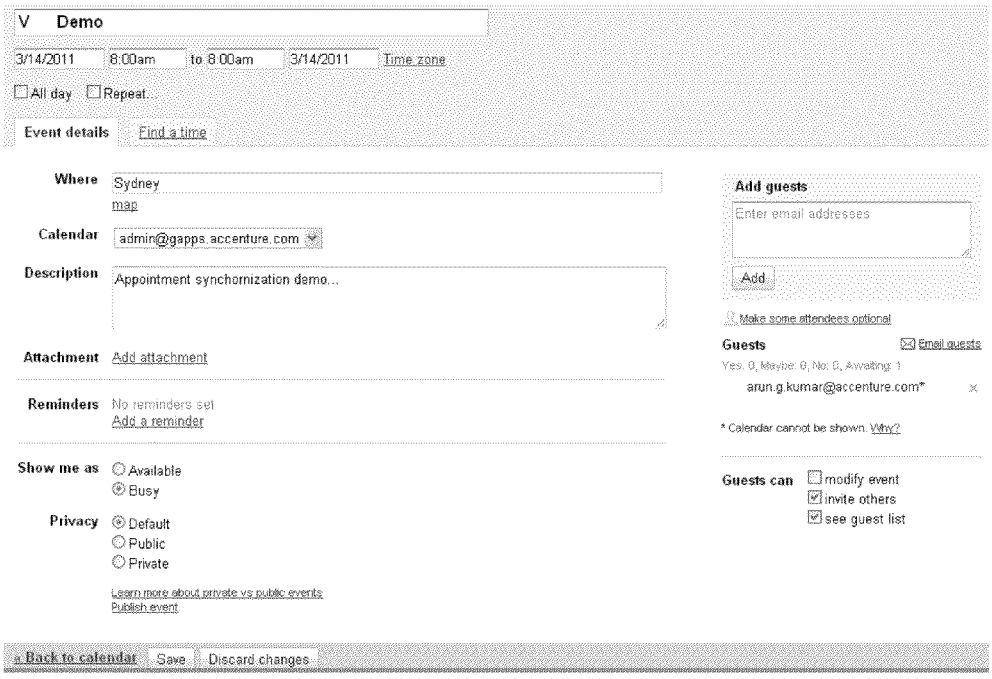

V Demo
3/14/2011 8:00am to 8:00am 3/14/2011 Time zone
All day Repeat...
Event details Find a time
Where Sydney
map
Calendar admin@gapps.accenture.com
Description Appointment synchornization demo...
Attachment Add attachment
Reminders No reminders set
Add a reminder
Show me as Available
Busy
Privacy Default
Public
Private
Learn more about private vs public events
Publish event
Add guests
Enter email addresses
Add
Make some attendees optional
Guests Email guests
Yes: 0, Maybe: 0, No: 0, Awaiting: 1
arun.g.kumar@accenture.com*
* Calendar cannot be shown. Why?
Guests can modify event
invite others
see guest list
« Back to calendar Save Discard changes

FIG. 20

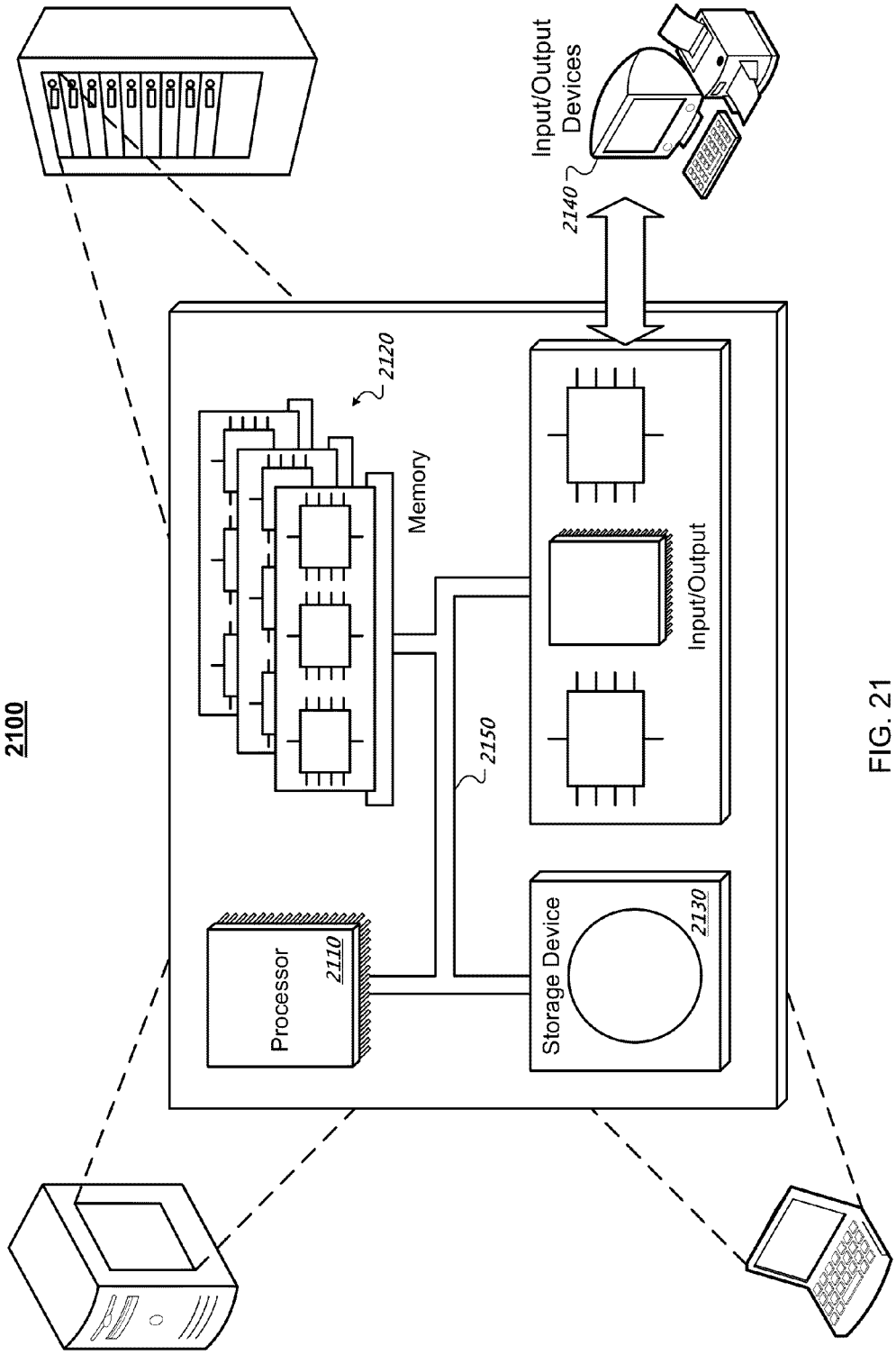

2100
Input/Output Devices
2140
2120
Memory
Input/Output
2150
Processor
2110
Storage Device
2130

FIG. 21

DATA EXCHANGE TECHNOLOGY

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application claims the benefit of Indian Patent Application No. 3012/CHE/2011, filed on Sep. 2, 2011, which is incorporated herein by reference in its entirety for all purposes.

FIELD

This disclosure relates to data exchange technology.

BACKGROUND

A company may use a customer relationship management (CRM) system to implement a strategy for managing the company's interactions with customers and sales prospects. The customer relationship management system may organize, automate, and synchronize business processes and handle sales related activities, marketing, customer service, and technical support.

Cloud computing is the use of computing resources (e.g., hardware and software) that are delivered as a service over a network (typically the Internet). Cloud computing entrusts remote services with a user's data, software, and computation.

SUMMARY

In one aspect, a data exchange adaptor synchronizes data between an enterprise system operated by a company and a cloud-based system operated by a third party other than the company. The data exchange adaptor includes at least one communication module configured to exchange data between the enterprise system operated by the company and the cloud-based system operated by the third party. The data exchange adaptor also includes at least one data controller configured to extract data from the at least one communication module and control storage and retrieval of data at the enterprise system and the cloud-based system. The data exchange adaptor further includes at least one authentication module configured to perform transport level security for communications that exchange data between the enterprise system and the cloud-based system and access level security for data stored to the enterprise system and the cloud-based system. In addition, the data exchange adaptor includes a job scheduler that is operated by the enterprise system and that is configured to control the at least one communication module, the at least one data controller, and the at least one authentication module to schedule synchronization of data between the enterprise system and the cloud-based system and allow the enterprise system to retain control over the synchronization of data between the enterprise system and the cloud-based system.

Implementations may include one or more of the following features. For example, the at least one communication module may be configured to exchange calendar data between the enterprise system operated by the company and the cloud-based system operated by the third party and the at least one data controller may be configured to extract calendar data from the at least one communication module and control storage and retrieval of calendar data at the enterprise system and the cloud-based system. In this example, the job scheduler may be configured to schedule synchronization of calendar data between the enterprise system and the cloud-based system such that a calendar maintained by the enterprise system is synchronized with a calendar maintained by the cloud-based system.

In some implementations, the at least one communication module may be configured to exchange contact data between the enterprise system operated by the company and the cloud-based system operated by the third party and the at least one data controller may be configured to extract contact data from the at least one communication module and control storage and retrieval of contact data at the enterprise system and the cloud-based system. In these implementations, the job scheduler may be configured to schedule synchronization of contact data between the enterprise system and the cloud-based system such that contacts maintained by the enterprise system are synchronized with contacts maintained by the cloud-based system.

In some examples, the at least one communication module may be configured to exchange task data between the enterprise system operated by the company and the cloud-based system operated by the third party and the at least one data controller may be configured to extract task data from the at least one communication module and control storage and retrieval of task data at the enterprise system and the cloud-based system. In these implementations, the job scheduler may be configured to schedule synchronization of task data between the enterprise system and the cloud-based system such that tasks maintained by the enterprise system are synchronized with tasks maintained by the cloud-based system.

The enterprise system may be a customer relationship management (CRM) system, the at least one communication module may be configured to exchange data between the CRM system operated by the company and the cloud-based system operated by the third party, and the at least one data controller may be configured to control storage and retrieval of data at the CRM system and the cloud-based system. In addition, the at least one authentication module may be configured to perform transport level security for communications that exchange data between the CRM system and the cloud-based system and access level security for data stored to the CRM system and the cloud-based system and the job scheduler may be operated by the CRM system and is configured to schedule synchronization of data between the CRM system and the cloud-based system and allow the CRM system to retain control over the synchronization of data between the CRM system and the cloud-based system. The job scheduler may be configured to trigger reverse synchronization from the cloud-based system to the CRM system.

In some implementations, the at least one communication module may include at least one web service module configured to exchange web-based requests and responses between the enterprise system operated by the company and the cloud-based system operated by the third party. In these implementations, the at least one web service module may include a first web service operated on the enterprise system and a second web service operated on the cloud-based system, where the first web service operated on the enterprise system and the second web service operated on the cloud-based system are configured to exchange web-based requests and responses with each other. Further, in these implementations, the first web service operated on the enterprise system may be a consumer web service operated on the enterprise system, the second web service operated on the cloud-based system may be a producer web service operated on the cloud-based system, and the producer web service operated on the cloud-based system may always be triggered by the consumer web service operated on the enterprise system.

Further, the job scheduler may be configured to periodically initiate a synchronization process after a particular period of time has passed since a most recent synchronization process. The job scheduler may be configured to initiate a synchronization process based on user input received to perform synchronization. The job scheduler may be configured to initiate a synchronization process based on a change to data maintained by the enterprise system.

In some examples, the at least one data controller may include a first data controller operated on the enterprise system and configured to control storage and retrieval of data at the enterprise system and a second data controller operated on the cloud-based system and configured to control storage and retrieval of data at the cloud-based system. In these examples, the first data controller may include a web-based user interface configured to enable selection and deselection of synchronization options and manual triggering of synchronization, a data injector configured to update data received from the cloud-based system to the enterprise system, a data extractor configured to extract data from the enterprise system and forward the extracted data to the cloud-based system for synchronization, an exception handler configured to check on a variety of exceptions and errors received while synchronization is in process, and a logging component configured to log events on a periodic basis. In addition, in these examples, the second data controller may include a service manager which provides controller service to access various services in the cloud-based system, a data injector configured to update data received from the enterprise system to the cloud-based system, a data extractor configured to extract data from the cloud-based system and forward the extracted data to the enterprise system for synchronization, an exception handler configured to check on a variety of exceptions and errors received while synchronization is in process, and a logging component configured to log events on a periodic basis.

The at least one authentication module may be configured to use a two-legged authentication mechanism to perform create, read, update, and delete operations in the cloud-based system. Also, the at least one authentication module may be configured to determine whether a consumer key and a secret for a domain are present for a requested operation, based on a determination that a consumer key or a secret for the domain are absent for the requested operation, decline the requested operation and provide an indication that no update operation will be performed, based on a determination that a consumer key and a secret for the domain are present for the requested operation, use a two-legged authentication process to authorize the consumer key and the secret for the domain, and, based on authorizing the consumer key and the secret for the domain, make a subsequent request to perform the requested operation.

In some implementations, the at least one communication module may include a first web service operated on the enterprise system and a second web service operated on the cloud-based system and the at least one authentication module may include a first encryption mechanism operated on the enterprise system and a second encryption mechanism operated on the cloud-based system. In these implementations, the at least one data controller may include a cloud data controller operated on the cloud-based system and the first web service may be configured to access data stored by the enterprise system, initiate the first encryption mechanism, and provide a request/response object to the first encryption mechanism. Further, in these implementations, the first encryption mechanism may be configured to encrypt a system provided key, add the system provided key to the request/response object, and provide an updated version of the request/response object to the first web service. Also, in these implementations, the first web service may be configured to send the updated version of the request/response object to the second web service and the second web service may be configured to receive the updated version of the request/response object and provide the updated version of the request/response object to the second encryption mechanism. In addition, in these implementations, the second encryption mechanism may be configured to segregate the encrypted key from the updated version of the request/response object, validate the segregated key against a reference key provided to the cloud-based system in advance, and forward the validated request/response object to the second web service for further processing, the second web service may be configured to forward the validated request/response object to the cloud data controller, and the cloud data controller may be configured to perform a data synchronization operation based on the validated request/response object.

In another aspect, at least one computer-readable storage medium is encoded with executable instructions that, when executed by at least one processor, cause the at least one processor to perform operations. The operations include exchanging data between an enterprise system operated by a company and a cloud-based system operated by a third party other than the company and controlling storage and retrieval of data at the enterprise system and the cloud-based system. The operations also include performing transport level security for communications that exchange data between the enterprise system and the cloud-based system and access level security for data stored to the enterprise system and the cloud-based system. The operations further include scheduling synchronization of data between the enterprise system and the cloud-based system in a manner that allows the enterprise system to retain control over the synchronization of data between the enterprise system and the cloud-based system.

In yet another aspect, a method includes using at least one communication module to exchange data between an enterprise system operated by a company and a cloud-based system operated by a third party other than the company and using at least one data controller to extract data from the at least one communication module and control storage and retrieval of data at the enterprise system and the cloud-based system. The method also includes using at least one authentication module to perform transport level security for communications that exchange data between the enterprise system and the cloud-based system and access level security for data stored to the enterprise system and the cloud-based system. The method further includes using a job scheduler that is operated by the enterprise system to schedule synchronization of data between the enterprise system and the cloud-based system and allow the enterprise system to retain control over the synchronization of data between the enterprise system and the cloud-based system.

The details of one or more implementations are set forth in the accompanying drawings and the description, below. Other potential features of the disclosure will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of an example system for performing data exchange.

FIG. **2** is a diagram of example communication between two web-service components.

FIG. **3** is a diagram of an example of data synchronization from a CRM system to a cloud system.

FIG. **4** is a diagram of an example of data synchronization from a cloud system to a CRM system.

FIG. **5** is a diagram of an example of a data controller that interacts with a CRM system.

FIG. **6** is a diagram of an example of a data controller that interacts with a cloud system.

FIG. **7** is a flow chart of an example authentication process.

FIG. **8** is a diagram of an example of transport-level security.

FIG. **9** is a diagram of an example of access-level security.

FIGS. **10-20** are example screenshots of example interfaces for a data exchange adaptor.

FIG. **21** is a diagram of an example system.

DETAILED DESCRIPTION

In one aspect, a data exchange adaptor synchronizes data between an enterprise system operated by a company and a cloud-based system operated by a third party other than the company. The data exchange adaptor may include at least one communication module configured to exchange data between the enterprise system operated by the company and the cloud-based system operated by the third party, and at least one data controller configured to extract data from the at least one communication module and control storage and retrieval of data at the enterprise system and the cloud-based system. The data exchange adaptor also may include at least one authentication module configured to perform transport level security for communications that exchange data between the enterprise system and the cloud-based system and access level security for data stored to the enterprise system and the cloud-based system. The data exchange adaptor further may include a job scheduler that is operated by the enterprise system and that is configured to control the at least one communication module, the at least one data controller, and the at least one authentication module to schedule synchronization of data between the enterprise system and the cloud-based system and allow the enterprise system to retain control over the synchronization of data between the enterprise system and the cloud-based system.

In some implementations, an adaptor tool exchanges data between two completely different systems: a customer relationship management system (e.g., SAP-CRM) and a cloud-based system (e.g., Google Apps). The adaptor provides a mechanism for users to synchronize their data from the CRM system to the cloud-based system. The communication mechanism provided by the adaptor, between these systems, is bi-directional. It includes Java Enterprise and ABAP based components including Web Services. The interaction between the systems happens via Producer and Consumer Web Services hosted in both systems. The following are the different modules of the adaptor: Web Service Module, Data Controller Module, Authentication Module, Security Module, and Job Scheduler

The adaptor tool components may be orchestrated in such a fashion that makes it a custom fit solution for most of the data exchange requirements in any CRM (e.g., SAP-CRM) implementation to a cloud-based system (e.g., Google Apps). In some examples, the adaptor framework, as mentioned above, includes five modules which work seamlessly with each other and provide the following three principal functionalities: Contact Synchronization, Appointment Synchronization, and Tasks Synchronization.

FIG. **1** illustrates an example system **100** for performing data exchange. As shown, the system **100** has a framework and a set of components for an implementation that involves a CRM system **140** (e.g., an SAP-CRM system) and a cloud system **110** (e.g., Google Apps).

The cloud system **110** includes cloud applications **120** and a cloud application engine **130**. The cloud applications **120** are applications offered by the cloud service provider that operates the cloud system **110**. The cloud applications **120** may include a calendar application **122**, a contact application **124**, and/or any other type of application offered by a cloud service provider.

The cloud application engine **130** includes an authentication module **132**, a cloud web service **134** portion of a web service module, and a data protocol application programming interface (API). The authentication module **132** authenticates requests to retrieve from and/or store data to the cloud applications **120** and enables data operations with the cloud applications **120** when the authentication module **132** deems a request to be authentic. The authentication module **132** blocks data operations with the cloud applications **120** when the authentication module **132** deems a request to be unauthentic.

The cloud web service **134** exchanges communications with the CRM system **140**. The cloud web service **134** also communicates with the authentication module **132** through the data protocol API **136**. For instance, the data protocol API **136** converts communications from the cloud web service **134** to a format that the authentication module **132** understands and also converts communications from the authentication module **132** to a format that the cloud web service **134** understands.

The CRM system **140** is operated by a company that is different than the cloud service provider that operates the cloud system **110**. The CRM system **140** includes a CRM web service **150** portion of a web service module, a programming layer **160**, user information **170** stored by the CRM system **140**, and a job scheduler **180**. The CRM web service **150** exchanges communications with the cloud system **110** (e.g., the cloud web service **134**). The CRM web service **150** also stores and retrieves data from the user information **170** and follows scheduling operations controlled by the job scheduler **180**. The programming layer **160** provides a framework that the CRM web service **150** uses to interact with the user information **170** and the job scheduler **180**.

The user information **170** may include appointment activities **172** maintained by the CRM system **140**, personal and contact details **174** maintained by the CRM system **140**, and/or any other type of data or service maintained by the CRM system **140**. The job scheduler **180** controls scheduling of synchronization between the cloud system **110** and the CRM system **140**. For example, the job scheduler **180** may periodically initiate a synchronization process after a particular period of time has passed since the last synchronization (e.g., initiate synchronization every ten minutes), initiate a synchronization process based on user input received to perform synchronization, and/or initiate a synchronization process based on a change to data maintained by the CRM system **140**.

Using the system **100**, the calendar data maintained by the cloud service provider through the calendar application **122** may be synchronized with the appointment activities **172** maintained by the different company operating the CRM system **140**. Also, using the system **100**, the contact data maintained by the cloud service provider through the contact application **124** may be synchronized with the personal and contact details **174** maintained by the different company operating the CRM system **140**. By enabling synchronization of data maintained by the cloud system **110** with data maintained by the CRM system **140**, the system **100** may enable

employees of the company operating the CRM system **140** flexibility in whether the employees prefer to use the cloud system **110** or the CRM system **140** for performing operations (e.g., calendar operations, contact management, task management, etc.). Because the data is synchronized between the cloud system **110** and the CRM system **140**, the company operating the CRM system **140** may be more comfortable that employees are using the cloud system **110**, as all of the data collected by the cloud system **110** is ultimately stored at the CRM system **140**, as well.

The Web service module made up of the cloud web service **134** and the CRM web service **150** is responsible for exchanging data between the CRM system **140** and the cloud system **110**. The Web service module may be the backbone of the framework provided by the system **100** and may play an important role in swapping over data between the different systems.

In some implementations, the CRM system **140** and the cloud system **110** are coupled to consumer and producer web services, respectively, with each deployed on different platforms. Both web services may intelligently communicate with each other based on actions performed, such as manual triggers (e.g., user initiated, on-click event) or automated triggers produced by a pre-scheduled trigger mechanism. For instance, the cloud web service **134** may be a producer web service and the CRM web service **150** may be a consumer web service.

FIG. **2** illustrates example communication between two web-service components. For example, a producer web service may be deployed on a cloud application engine (e.g., Google Application Engine (GAE)). The cloud application engine may be a Platform-as-a-Service provided by the cloud service provider. In this example, the producer web service, at all times, is triggered from the CRM system. The producer web service also distinguishes the difference between the types of requests received, and performs the required functionality which involves receiving data from the CRM system and forwarding it to data controllers deployed at the cloud application engine and sharing the data from the cloud system and forwarding it to data controllers deployed at the CRM system.

The producer web service may be consumed through a client proxy generated in a workbench (e.g., an ABAP workbench) using a document (e.g., WSDL document) provided by web service. The producer web service sends the response back to the system in order to complete the synchronization request.

The consumer web service is hosted at the CRM system with the objective to provide better control of the adaptor on the client's side. The consumer web service triggers the producer web service and passes over the data to it in case of manual operations (e.g., a user initiated, on-click event). The consumer web service also connects to the producer web service whenever a job executes at a pre-scheduled time. In this case, the consumer web service plays the role of receiving the updated data from the cloud system and syncing it to the client system (e.g., the CRM system).

As shown in FIG. **2**, a service requester **210** exchanges messages with a service provider **220**. The service requester **210** may be a consumer web service hosted at a CRM system. The service provider **220** may be a producer web service deployed on a cloud application engine by a cloud service provider. The service requester **210** sends a request extensible markup language (XML) message **230** to the service provider **220** using the simple object access protocol (SOAP). The service provider **220** receives the request XML message **230**, performs the data operations requested by the request XML message **230**, and sends a response XML message **240** to the service requester **210** using SOAP. The service requester **210** receives the response XML message **240** and uses the response XML message **240** to confirm that all synchronization operations have been completed or determine the data operations needed at the service requester **210** to complete synchronization.

In some implementations, data controllers are responsible for extracting data from the web services. In these implementations, the data controllers also are responsible for providing the data back to the web services. The system may use two data controller components: a first data controller that interacts with the client system (e.g., the CRM system) and a second data controller that interacts with the cloud system.

The first data controller may be an ABAP Data Controller for interaction with an SAP-CRM system. The data synchronization between the CRM system and the cloud system may occur in two phases. The first phase is data transfer from the CRM system to the cloud system, triggered by manual user input. In the first phase, data is retrieved from the CRM system and passed to the client proxy class bound with the web service. The data sent is processed by the web service for sending it across to the producer web service.

The second phase is the transfer of data from the cloud system to the CRM system, triggered through a set of scheduled jobs. A periodic job scheduler runs the client proxies which in turn request data from the web service. The producer web service transmits recently updated/modified data as a SOAP response. The data received is parsed, processed and updated in the CRM system. The following sections depict these phases in more detail.

FIG. **3** illustrates an example of data synchronization from a CRM system to a cloud system. As shown, FIG. **3** depicts the sequence of action that takes place when a synchronize event is triggered (e.g., manually triggered) from the CRM system. When the event is triggered **310**, an intermediate application **320** fetches the data from the client's CRM database **330** and passes on the fetched data to the client proxy **340**.

FIG. **4** illustrates an example of data synchronization from a cloud system to a CRM system **410**. As shown, FIG. **4** depicts the sequence of action that takes place when the job scheduler **430** triggers a web service **420** in the CRM system **410**. The cloud web service **440** fetches the data which is further passed as the response of the called web service. The client proxy **422** residing in the CRM system **410** receives the response, parses the response data, and updates the CRM database **450** with the parsed response data.

FIG. **5** illustrates an example of a data controller **500** that interacts with a CRM system. The data controller **500** includes a web user interface **510**, a data injector **520**, a data extractor **530**, a job scheduler **540**, an exception handler **550**, a logging component **560**, and a CRM database **570**. The web user interface **510** is a web-based user interface for administration activities like selecting/deselecting the synchronization option and manual triggering the synchronization.

The data injector **520** updates the data received from the cloud system to the CRM system. The data extractor **530** extracts the data from the client system and forwards the extracted data to the cloud system for synchronization. The job scheduler **540** schedules synchronization processes to periodically occur in accordance with a user-defined time period.

The exception handler **550** is an exception handling mechanism that keeps a check on a variety of exceptions and errors received while the synchronization is in process. The

exceptions and errors may include web-service faults, user-entered faults, data transfer exceptions, and system specific exceptions.

The logging component **560** logs events on a periodic (e.g., daily) basis. Logging occurs when any exception is captured during the synchronization process. The detailed logs may provide enough information to capture any difference in the process.

The CRM database **570** is the client database where all the information is stored. The data stored in the CRM database **570** is the information used to synchronize with the cloud system.

FIG. **6** illustrates an example of a data controller **600** that interacts with a cloud system. The request received from the client system is forwarded to the data controller **600** via the producer web service. In return, based on the request type, the data controller **600** performs the corresponding action.

When the request is to synchronize data from the CRM system to the cloud system, the data controller **600** extracts the data, passed from the CRM system through the producer web service, and synchronizes the extracted data to the cloud system. For the request to synchronize data to the CRM system, the data controller **600** fetches the data from the cloud system and passes it to the producer web service. The data is added as a response that the producer web service passes on to the consumer web service.

The data controller **600** includes a service manager **610**, a data injector **620**, a data extractor **630**, an exception handler **640**, and a logging component **650**. The service manager **610** is a service object which provides controller service to access the various services in the cloud system (e.g., calendar/contact details).

The data injector **620** updates the data received from the client system to the cloud system. The data extractor **630** extracts the data from the cloud system and forwards the extracted data to the client system for synchronization.

The exception handler **640** is an exception handling mechanism that keeps a check on a variety of exceptions and errors received while the synchronization is in process. The exceptions and errors may include web-service faults, user-entered faults, data transfer exceptions and cloud system specific exceptions.

The logging component **650** logs events on a periodic (e.g., daily) basis. Logging occurs when any exception is captured during the synchronization process. The detailed logs may provide enough information to capture any difference in the process. The logging may be maintained at the client system, even for updates that occur on the third party cloud-based system.

FIG. **7** illustrates an example authentication process **700**. The cloud system performs Create, Read, Update and Delete (CRUD) operations (**710**). All of the CRUD operations performed within the cloud system are authenticated via an authentication module. Each request to synchronize data has to pass through the authentication module to perform any synchronization operations. The adaptor uses a two-legged authentication mechanism to perform CRUD operations in the cloud system. Implementing two-legged authentication provides seamless user experience as no human interference is required during the entire authentication process.

The adaptor keeps a check on any unauthenticated data access/update requests. The data synchronization will fail to perform if authentication fails at any level.

For example, the adaptor determines whether a consumer key and a secret for the domain are present for a requested operation (**720**). Based on a determination that a consumer key and/or a secret for the domain are absent for a requested operation, the adaptor declines the request and provides an indication that no update operation will be performed (**730**).

Based on a determination that a consumer key and a secret for the domain are present for a requested operation, the adaptor uses a two-legged authentication process to authorize the consumer key and the secret for the domain (**740**). Based on authorizing the consumer key and the secret for the domain, the adaptor makes a subsequent request (e.g., API request) to perform the CRUD operation requested (**750**).

In some examples, a security component performs security for the web services. In these examples, the security component is responsible to ensure security in the web services. The security component may handle security at two levels: transport-level security and access-level security.

In performing transport-level security, the security component may be responsible for configuring the logic to secure the connection between the web services with Secure Sockets Layer (SSL). The logic may be configured in such a way that whenever the web service is initiated from the CRM system using "http://" it will be redirected to a secure connection "https://". This mechanism helps ensure secure connection by allowing two web services to authenticate each other's identity. The data is then exchanged in an encrypted format between them.

FIG. **8** illustrates an example of transport-level security. As shown, a cloud web service **810** extracts cloud system data **820** (e.g., contacts, appointments, tasks, etc.) and encrypts **830** the cloud system data **820** prior to transport. The encrypted data **840** is transported to the CRM system. The CRM system decrypts **850** the encrypted data **840** and generates CRM system data **860** (e.g., contacts, appointments, tasks, etc.). The CRM web service **870** accesses the CRM system data **860** and uses the CRM system data **860** to synchronize the CRM database.

In performing access-level security, the security component may be implemented at both ends: the CRM system and the cloud system. The security component encrypts the key which is passed along with the data sent over the web service. The component on the receiving end validates the encrypted key to ensure authorized access.

FIG. **9** illustrates an example of access-level security. As shown, in the first operation, CRM data **910** is passed to the web service **920**. In the second operation, an encryption mechanism **930** is initiated from within the web service **920**. In the third operation, a system provided key is encrypted and added to the request/response object coming from the web service **920**. In the fourth operation, the request along with the encrypted key is passed on to the web service **940** hosted in the cloud system. In the fifth operation, the request is passed to an encryption mechanism **950**, where the encrypted key is segregated from the request (coming from the CRM system) and validated against the key provided to the cloud system in advance. If the encryption mechanism **950** determines that the keys match, then, as the sixth operation, the request is validated and forwarded for further processing. If the encryption mechanism **950** determines that the keys do not match, the request is terminated indicating an unauthorized access, as the seventh operation. In the eighth operation, the validated request is forwarded to the cloud data controller **960**.

In some examples, a job scheduler is used to schedule synchronization processes. In these examples, the main purpose of the job scheduler is to trigger reverse synchronization from the cloud system to the CRM system.

The job scheduler offers control of the adaptor on the client system. The jobs scheduled at predefined times trigger the consumer web service, which in turn requests the producer

web service to get the data from the cloud system. In this regard, the client system retains control over the synchronization processes.

With increasing usage of cloud computing across different industries like telecommunications, information technology, manufacturing, automobile, retail, etc., the adaptor framework described throughout this disclosure may offer a valuable service. These industries may use CRM (e.g., SAP-CRM) implementations and in one way or another may target to utilize the cloud technology to reap its benefits. As described above, one such feature of its utilization may be co-existence of a CRM system (e.g., an SAP-CRM system) along with a cloud system (e.g., Google Apps).

A customer may receive several benefits from using one or more of the example data exchange connectors described throughout this disclosures. For instance, the data exchange adaptor may be employed as an easy plug-n-play tool. With minimum deployment hassles and configuration settings, the adaptor may be ready to provide synchronization for clients.

The data exchange adaptor also may provide secured data transfer. With message level and transport level security in place, the data synchronization may be highly secured.

The data exchange adaptor further may be deployed with reduced infrastructure cost. Minimal (or no) additional infrastructure cost may be incurred as the tool may only utilize existing systems. This, in turn, also may result in reduced time to market

In addition, the data exchange adaptor may be deployed with near zero maintenance cost. For example, one part of the adaptor may use the existing system, which may result in zero maintenance increase. And, with cloud computing as the foundation framework for the adaptor tool, the maintenance required may reduce considerably.

With cloud computing as its base structure, the data exchange adaptor may experience any one or more of all the cloud computing benefits. For instance, the data exchange adaptor may experience no licensing issues, less maintenance, hassle-free software updates, and/or high scalability based on load.

FIGS. **10-20** illustrate example screenshots for a data exchange adaptor. The screenshots may be used for an example data exchange adaptor that synchronizes data between a CRM system (e.g., an SAP-CRM system) and a cloud system (e.g., Google Apps). Other types of client-operated enterprise systems may be synchronized with other types of third-party operated cloud-based systems using similar screenshots and similar techniques to those described throughout this disclosure.

FIG. **10** illustrates an example interface **1000**. The interface **1000** enables contact synchronization between a CRM system and a cloud system. As shown, the interface **1000** enables a user to navigate to an "Account Management—Contacts" option from a navigation bar to create a contact.

FIG. **11** illustrates an example interface **1100** displayed in response to selection of the "Account Management—Contacts" option from the navigation bar included in the interface **1000**. The interface **1100** includes a variety of input fields that receive user input to define contact information for a new contact. After information for the new contact has been received in the input fields of the interface **1100**, the new contact is saved to the CRM system, as shown in an example interface **1200** illustrated in FIG. **12**.

FIG. **13** illustrates an example interface **1300**. The interface **1300** enables contact synchronization between a CRM system and a cloud system. As shown, the interface **1300** enables a user to navigate to an "Account Management—Contact Synchronization" option from a navigation bar.

FIG. **14** illustrates an example interface **1400** displayed in response to selection of the "Account Management—Contact Synchronization" option from the navigation bar included in the interface **1300**. The interface **1400** includes a variety of input fields that receive user input to define search criteria. After search criteria has been received in the input fields of the interface **1400** and the search button has been selected, the CRM system performs a search based on the search criteria.

Results of the search are displayed in a result list portion of the interface **1400**. To synchronize one or more contacts from the CRM system to the cloud system, a user selects the one or more contacts from the search result list and clicks the synchronize button. Based on selection of the synchronize button, selected contact details are updated to the cloud system and the synchronization status is displayed.

FIG. **15** illustrates an example interface **1500** from the cloud system after synchronization has occurred. The interface **1500** is displayed after a user has logged into the cloud system and navigated to a contacts area. As shown, the interface **1500** displays the contact from the CRM system and indicates that the data for the contact has been synchronized from the CRM system.

FIG. **16** illustrates an example interface **1600**. The interface **1600** enables appointment synchronization between a CRM system and a cloud system. As shown, the interface **1600** enables a user to navigate to a "Create—Appointment" option using a direct link from a navigation bar.

FIG. **17** illustrates an example interface **1700** displayed in response to selection of the "Create—Appointment" option from the navigation bar included in the interface **1600**. The interface **1700** includes a variety of input fields that receive user input to define appointment information for a new appointment. After information for the new appointment has been received in the input fields of the interface **1700**, the new appointment is saved to the CRM system in response to selection of a save input button. Once the appointment is saved, an appointment invite is sent to the contact person defined in the appointment.

FIG. **18** illustrates an example interface **1800** of an invite sent based on the appointment created using the interface **1700**. The invite shown in the interface **1800** is an electronic mail message sent to an electronic mail address for the contact person defined in the appointment.

FIG. **19** illustrates an example interface **1900** from the cloud system after synchronization of the appointment has occurred. As shown, the appointment created using the interface **1700** has been replicated to the calendar maintained by the cloud system. The invite is updated to the cloud system calendar in parallel to being sent to the electronic mail address for the contact person defined in the appointment.

FIG. **20** illustrates an example interface **2000** from the cloud system after selection of the synchronized appointment shown in the interface **1900**. The interface **2000** shows the details of the synchronized appointment. As shown, the interface **2000** displays the appointment from the CRM system and includes the data for the appointment mapped to appropriate fields of the cloud system appointment record.

FIG. **21** is a schematic diagram of an example of a generic computer system **2100**. The system **2100** can be used for the operations described in association with the processes described throughout this disclosure. The system **2100** may be included in the systems described throughout this disclosure.

The system **2100** includes a processor **2110**, a memory **2120**, a storage device **2130**, and an input/output device **2140**. Each of the components **2110**, **2120**, **2130**, and **2140** are interconnected using a system bus **2150**. The processor **2110**

is capable of processing instructions for execution within the system **2100**. In one implementation, the processor **2110** is a single-threaded processor. In another implementation, the processor **2110** is a multi-threaded processor. The processor **2110** is capable of processing instructions stored in the memory **2120** or on the storage device **2130** to display graphical information for a user interface on the input/output device **2140**.

The memory **2120** stores information within the system **2100**. In one implementation, the memory **2120** is a computer-readable medium. In one implementation, the memory **2120** is a volatile memory unit. In another implementation, the memory **2120** is a non-volatile memory unit.

The storage device **2130** is capable of providing mass storage for the system **2100**. In one implementation, the storage device **2130** is a computer-readable medium.

In various different implementations, the storage device **2130** may be a floppy disk device, a hard disk device, an optical disk device, or a tape device.

The input/output device **2140** provides input/output operations for the system **2100**. In one implementation, the input/output device **2140** includes a keyboard and/or pointing device. In another implementation, the input/output device **2140** includes a display unit for displaying graphical user interfaces.

The features described can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. The apparatus can be implemented in a computer program product tangibly embodied in an information carrier, e.g., in a machine-readable storage device, for execution by a programmable processor; and method steps can be performed by a programmable processor executing a program of instructions to perform functions of the described implementations by operating on input data and generating output. The described features can be implemented advantageously in one or more computer programs that are executable on a programmable system including at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system, at least one input device, and at least one output device. A computer program is a set of instructions that can be used, directly or indirectly, in a computer to perform a certain activity or bring about a certain result. A computer program can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for use in a computing environment.

Suitable processors for the execution of a program of instructions include, by way of example, both general and special purpose microprocessors, and the sole processor or one of multiple processors of any kind of computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The elements of a computer are a processor for executing instructions and one or more memories for storing instructions and data. Generally, a computer will also include, or be operatively coupled to communicate with, one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

To provide for interaction with a user, the features can be implemented on a computer having a display device such as a CRT (cathode ray tube) or LCD (liquid crystal display) monitor for displaying information to the user and a keyboard and a pointing device such as a mouse or a trackball by which the user can provide input to the computer.

The features can be implemented in a computer system that includes a back-end component, such as a data server, or that includes a middleware component, such as an application server or an Internet server, or that includes a front-end component, such as a client computer having a graphical user interface or an Internet browser, or any combination of them. The components of the system can be connected by any form or medium of digital data communication such as a communication network. Examples of communication networks include, e.g., a LAN, a WAN, and the computers and networks forming the Internet.

The computer system can include clients and servers. A client and server are generally remote from each other and typically interact through a network, such as the described one. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. Accordingly, other implementations are within the scope of the following claims.

What is claimed is:

1. A data exchange adaptor that synchronizes data between a customer relationship management (CRM) system operated by a company and a cloud-based system operated by a third party other than the company, the CRM system being configured to provide a user interface for receipt of the data from a user, the cloud-based system being configured to store the data for the CRM system, and the data exchange adaptor comprising:

at least one communication module;

at least one data controller;

at least one authentication module;

a job scheduler that is operated by the CRM system;

one or more processors and one or more storage devices storing instructions that are operable, when executed by the one or more processors, to cause the one or more processors to perform operations comprising:

causing the at least one communication module to exchange data between the CRM system operated by the company and the cloud-based system operated by the third party;

causing the at least one data controller to extract data from the at least one communication module and control storage and retrieval of data at the CRM system and the cloud-based system;

causing the at least one authentication module to perform transport level security for communications that exchange data between the CRM system and the cloud-based system and access level security for data stored to the CRM system and the cloud-based system; and

causing the job scheduler to control the at least one communication module, the at least one data controller, and the at least one authentication module to schedule synchronization of data between the CRM system and the cloud-based system, including trigger-

ing reverse synchronization from the cloud-based system to the CRM system, and allow the CRM system to retain control over the synchronization of data between the CRM system and the cloud-based system such that reverse synchronization from the cloud-based system to the CRM system is always triggered by the CRM system sending a reverse synchronization message to the cloud-based system.

2. The data exchange adaptor of claim **1** wherein the operations comprise:

causing the at least one communication module to exchange calendar data between the CRM system operated by the company and the cloud-based system operated by the third party;

causing the at least one data controller to extract calendar data from the at least one communication module and control storage and retrieval of calendar data at the CRM system and the cloud-based system; and

causing the job scheduler to schedule synchronization of calendar data between the CRM system and the cloud-based system such that a calendar maintained by the CRM system is synchronized with a calendar maintained by the cloud-based system.

3. The data exchange adaptor of claim **1** wherein the operations comprise:

causing the at least one communication module to exchange contact data between the CRM system operated by the company and the cloud-based system operated by the third party;

causing the at least one data controller to extract contact data from the at least one communication module and control storage and retrieval of contact data at the CRM system and the cloud-based system; and

causing the job scheduler to schedule synchronization of contact data between the CRM system and the cloud-based system such that contacts maintained by the CRM system are synchronized with contacts maintained by the cloud-based system.

4. The data exchange adaptor of claim **1** wherein the operations comprise:

causing the at least one communication module to exchange task data between the CRM system operated by the company and the cloud-based system operated by the third party;

causing the at least one data controller to extract task data from the at least one communication module and control storage and retrieval of task data at the CRM system and the cloud-based system; and

causing the job scheduler to schedule synchronization of task data between the CRM system and the cloud-based system such that tasks maintained by the CRM system are synchronized with tasks maintained by the cloud-based system.

5. The data exchange adaptor of claim **1**, wherein:

the at least one communication module comprises at least one web service module; and

the operations comprise causing the web service module to exchange web-based requests and responses between the CRM system operated by the company and the cloud-based system operated by the third party.

6. The data exchange adaptor of claim **5**, wherein the at least one web service module comprises:

a first web service operated on the CRM system; and

a second web service operated on the cloud-based system,

wherein the operations comprise causing the first web service operated on the CRM system and the second web service operated on the cloud-based system to exchange web-based requests and responses with each other.

7. The data exchange adaptor of claim **6**:

wherein the first web service operated on the CRM system is a consumer web service operated on the CRM system; and

wherein the second web service operated on the cloud-based system is a producer web service operated on the cloud-based system.

8. The data exchange adaptor of claim **1**, wherein the operations comprise causing the job scheduler to periodically initiate a synchronization process after a particular period of time has passed since a most recent synchronization process.

9. The data exchange adaptor of claim **1**, wherein the operations comprise causing the job scheduler to initiate a synchronization process based on user input received to perform synchronization.

10. The data exchange adaptor of claim **1**, wherein the operations comprise causing the job scheduler to initiate a synchronization process based on a change to data maintained by the CRM system.

11. The data exchange adaptor of claim **1**, wherein:

the at least one data controller comprises:

a first data controller operated on the CRM system; and

a second data controller operated on the cloud-based system; and

the operations comprise:

causing the first data controller to control storage and retrieval of data at the CRM system; and

causing the second data controller to control storage and retrieval of data at the cloud-based system.

12. The data exchange adaptor of claim **11** wherein:

the first data controller comprises:

a web-based user interface,

a first data injector,

a first data extractor,

first exception handler, and

a first logging component;

the second data controller comprises:

a service manager,

a second data injector,

a second data extractor,

a second exception handle, and

a second logging component; and

the operations comprise:

causing the web-based user interface to enable selection and deselection of synchronization options and manual triggering of synchronization,

causing the first data injector to update data received from the cloud-based system to the CRM system,

causing the first data extractor to extract data from the CRM system and forward the extracted data to the cloud-based system for synchronization,

causing the first exception handler to check on a variety of exceptions and errors received while synchronization is in process,

causing the first logging component to log events on a periodic basis;

causing the service manager to provide a controller service to access various services in the cloud-based system,

causing the second data injector to update data received from the CRM system to the cloud-based system,

causing the second data extractor to extract data from the cloud-based system and forward the extracted data to the CRM system for synchronization,

causing the second exception handler to check on a variety of exceptions and errors received while synchronization is in process, and

causing the second logging component to log events on a periodic basis.

13. The data exchange adaptor of claim **1**, wherein the operations comprise causing the at least one authentication module to use a two-legged authentication mechanism to perform create, read, update, and delete operations in the cloud-based system.

14. The data exchange adaptor of claim **1**, wherein the operations comprise causing the at least one authentication module to:

determine whether a consumer key and a secret for a domain are present for a requested operation;

based on a determination that a consumer key or a secret for the domain are absent for the requested operation, decline the requested operation and provide an indication that no update operation will be performed;

based on a determination that a consumer key and a secret for the domain are present for the requested operation, use a two-legged authentication process to authorize the consumer key and the secret for the domain; and

based on authorizing the consumer key and the secret for the domain, make a subsequent request to perform the requested operation.

15. The data exchange adaptor of claim **1**:

wherein the at least one communication module comprises a first web service operated on the CRM system and a second web service operated on the cloud-based system;

wherein the at least one authentication module comprises a first encryption mechanism operated on the CRM system and a second encryption mechanism operated on the cloud-based system;

wherein the at least one data controller comprises a cloud data controller operated on the cloud-based system; and

wherein the operations comprise:

causing the first web service to access data stored by the CRM system, initiate the first encryption mechanism, and provide a request/response object to the first encryption mechanism;

causing the first encryption mechanism to encrypt a system provided key, add the system provided key to the request/response object, and provide an updated version of the request/response object to the first web service;

causing the first web service to send the updated version of the request/response object to the second web service;

causing the second web service to receive the updated version of the request/response object and provide the updated version of the request/response object to the second encryption mechanism;

causing the second encryption mechanism to segregate the encrypted key from the updated version of the request/response object, validate the segregated key against a reference key provided to the cloud-based system in advance, and forward the validated request/response object to the second web service for further processing;

causing the second web service to forward the validated request/response object to the cloud data controller; and

causing the cloud data controller to perform a data synchronization operation based on the validated request/response object.

16. At least one non-transitory computer-readable storage medium encoded with executable instructions that, when executed by at least one processor, cause the at least one processor to perform operations comprising:

exchanging data between a customer relationship management (CRM) system operated by a company and a cloud-based system operated by a third party other than the company, the CRM system being configured to provide a user interface for receipt of the data from a user and the cloud-based system being configured to store the data for the CRM system;

controlling storage and retrieval of data at the CRM system and the cloud-based system;

performing transport level security for communications that exchange data between the CRM system and the cloud-based system and access level security for data stored to the CRM system and the cloud-based system; and

scheduling synchronization of data between the CRM system and the cloud-based system, including triggering reverse synchronization from the cloud-based system to the CRM system, in a manner that allows the CRM system to retain control over the synchronization of data between the CRM system and the cloud-based system such that reverse synchronization from the cloud-based system to the CRM system is always triggered by the CRM system sending a reverse synchronization message to the cloud-based system.

17. A method comprising:

using at least one communication module to exchange data between a customer relationship management (CRM) system operated by a company and a cloud-based system operated by a third party other than the company, the CRM system being configured to provide a user interface for receipt of the data from a user and the cloud-based system being configured to store the data for the CRM system;

using at least one data controller to extract data from the at least one communication module and control storage and retrieval of data at the CRM system and the cloud-based system;

using at least one authentication module to perform transport level security for communications that exchange data between the CRM system and the cloud-based system and access level security for data stored to the CRM system and the cloud-based system; and

using a job scheduler that is operated by the CRM system to schedule synchronization of data between the CRM system and the cloud-based system, including triggering reverse synchronization from the cloud-based system to the CRM system, and allow the CRM system to retain control over the synchronization of data between the CRM system and the cloud-based system such that reverse synchronization from the cloud-based system to the CRM system is always triggered by the CRM system sending a reverse synchronization message to the cloud-based system.

18. The method of claim **17** comprising:

using a web-based user interface that is operated by the CRM system to enable selection and deselection of synchronization options and manual triggering of synchronization,

using a first data injector that is operated by the CRM system to update data received from the cloud-based system to the CRM system,

using a second data extractor that is operated by the CRM system to extract data from the CRM system and forward the extracted data to the cloud-based system for synchronization,

using a first exception handler that is operated by the CRM system to check on a variety of exceptions and errors received while synchronization is in process,

using a first logging component that is operated by the CRM system to log events on a periodic basis;

using a service manager that is operated by the cloud-based system to provide controller service to access various services in the cloud-based system,

using a second data injector that is operated by the cloud-based system to update data received from the CRM system to the cloud-based system,

using a second data extractor that is operated by the cloud-based system to extract data from the cloud-based system and forwarding the extracted data to the CRM system for synchronization,

using a second exception handler that is operated by the cloud-based system to check on a variety of exceptions and errors received while synchronization is in process, and

using a second logging component that is operated by the cloud-based system to log events on a periodic basis.

19. The non-transitory computer-readable storage medium of claim **16** the operations comprising:

enabling, using a web-based user interface included in the CRM system, selection and deselection of synchronization options and manual triggering of synchronization,

updating, using a first data injector included in the CRM system, data received from the cloud-based system to the CRM system,

extracting, using a first data extractor that is operated by the CRM system, data from the CRM system and forwarding the extracted data to the cloud-based system for synchronization,

checking, using a first exception handler that is operated by the CRM system, a variety of exceptions and errors received while synchronization is in process,

logging, using a first logging component that is operated by the CRM system, events on a periodic basis;

providing, using a service manager that is operated by the cloud-based system, controller service to access various services in the cloud-based system,

updating, using a second data injector that is operated by the cloud-based system, data received from the CRM system to the cloud-based system,

extracting, using a second data extractor that is operated by the cloud-based system, data from the cloud-based system and forwarding the extracted data to the CRM system for synchronization,

checking, using a second exception handler that is operated by the cloud-based system, a variety of exceptions and errors received while synchronization is in process, and

logging, using a second logging component that is operated by the cloud-based system, events on a periodic basis.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,059,894 B2
APPLICATION NO. : 13/598947
DATED : June 16, 2015
INVENTOR(S) : Saurabh Saraswat et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In claim 12, column 16, line 44, delete "handle," and insert -- handler, --.

Signed and Sealed this
Eighth Day of December, 2015

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office